What is claimed is:

SUB B1

1. A method for coding an input object mask, where said input object mask has a plurality of regions, said method comprising the steps of:

(a) assigning at least one symbol to each of the plurality of regions;

(b) coding said assigned symbols of the input object mask;

(c) decomposing said input object mask into a plurality of object mask layers;

(d) coding a base object layer of said plurality of object mask layers; and

(e) coding a next higher layer of said plurality of object mask layers in accordance with information from a lower object mask layer.

2. The method of claim 1, wherein said coding step (b) codes said assigned symbols contextually in accordance with neighboring regions.

3. The method of claim 2, wherein said coding step (b) codes said assigned symbols contextually in accordance with:

$$context_0 = S_3 * 27 + S_2 * 9 + S_1 * 3 + S_0,$$

where $context_0$ is a context for an assigned symbol for a current region, M_{ij}, to be coded, i and j are respectively row index and column index, and wherein said neighboring regions are defined as $S_3=M_{(i-1)(j-1)}$, $S_2=M_{(i-1)j}$, $S_1=M_{(i-1)(j+1)}$, and $S_0=M_{i(j-1)}$.

4. The method of claim 1, wherein said coding step (b) codes said assigned symbols contextually using binary context-based arithmetic coding.

5. The method of claim 4, wherein said coding step (b) codes said assigned symbols contextually using binary context-based arithmetic coding having two classes.

6. The method of claim 1, wherein said coding step (d) codes mask values of said base object layer contextually in accordance with neighboring regions.

7. The method of claim 6, wherein said coding step (d) codes said mask values of said base object layer contextually in accordance with:

$$context_1 = (C_9<<9) \mid (C_8<<8) \mid (C_7<<7) \mid (C_6<<6) \mid (C_5<<5) \mid (C_4<<4) \mid (C_3<<3) \mid (C_2<<2) \mid (C_1<<1) \mid C_0,$$

where "<<" is a left-shift operation, "|" is a bit wise logical OR operation, $context_1$ is a context for a current base-layer mask value (m^L_{ij}) to be coded, i and j are respectively row index and column index, and wherein said neighboring regions are defined as $C_9 = m^L_{(i-2)(j-1)}$, $C_8 = m^L_{(i-2)j}$, $C_7 = m^L_{(i-2)(j+1)}$, $C_6 = m^L_{(i-1)(j-2)}$, $C_5 = m^L_{(i-1)(j-1)}$, $C_4 = m^L_{(i-1)j}$, $C_3 = m^L_{(i-1)(j+1)}$, $C_2 = m^L_{(i-1)(j+2)}$, $C_1 = m^L_{i(j-2)}$, and $C_0 = m^L_{i(j-1)}$.

8. The method of claim 1, wherein said coding step (e) codes a region, V^n, within said next higher layer of said plurality of object mask layers, wherein said region is represented as:

$$V^n = m^n_{(2i)(2j)} * 8 + m^n_{(2i)(2j+1)} * 4 + m^n_{(2i+1)(2j)} * 2 + m^n_{(2i+1)(2j+1)}$$

where i and j are row and column indices of said region, V^n, corresponding to in a previous lower spatial object layer.

9. The method of claim 1, wherein said coding step (e) codes a current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$context_2 = (T_7<<7) \mid (T_6<<6) \mid (T_5<<5) \mid (T_4<<4) \mid (T_3<<3) \mid (T_2<<2) \mid (T_1<<1) \mid (T_0),$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_2$ is a context for said current region within said next higher layer to be coded, i and j are respectively row index and column index, $T_7=m^n_{(2i-1)(2j)}$, $T_6=m^n_{(2i-1)(2j+1)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and $m^n_{(x)(y)}$ denotes the mask value at position (x,y) in a lower spatial object layer.

10. The method of claim 1, wherein said coding step (e) codes a current region within said next higher layer of said plurality of object mask layers contextually in two-passes using a half-higher spatial layer.

11. The method of claim 10, wherein said coding step (e) codes in a first pass said current region having a plurality of pixels, wherein at least one of said plurality of pixels is coded contextually in accordance with:

$$Context_3 = (T_9<<7)|\ (T_8<<6)|\ (T_7<<5)|\ (T_6<<4)|\ (T_5<<3)|\ (T_4<<2)|\ (T_3<<1)|\ (T_2),$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_3$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_9=m^{n+1/2}_{(2i-1)(j)}$, $T_8=m^{n+1/2}_{(2i-1)(j+1)}$, $T_7=m^{n+1/2}_{(2i+1)(j-1)}$, $T_6=m^{n+1/2}_{(2i)(j-1)}$, $T_5=m^{n+1}_{(i)(j)}$, $T_4=m^{n+1}_{(i)(j+1)}$, $T_3=m^{n+1}_{(i+1)(j)}$, $T_2=m^{n+1}_{(i+1)(j+1)}$, where T_6 through T_9 correspond to pixels in said half-higher spatial object layer, and T_5 through T_2 and T_{10} correspond to pixels in a lower spatial object layer.

12. The method of claim 10, wherein said coding step (e) codes in a first pass said current region having a plurality of pixels, wherein at least one of said plurality of pixels is coded contextually in accordance with:

$$Context_4 = (T_1<<7)|\ (T_{10}<<6)|\ (T_7<<5)|\ (T_6<<4)|\ (T_5<<3)|\ (T_4<<2)|\ (T_3<<1)|\ (T_2),$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_4$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_7=m^{n+1/2}_{(2i+1)(j-1)}$, $T_6=m^{n+1/2}_{(2i)(j-1)}$, $T_5=m^{n+1}_{(i)(j)}$, $T_4=m^{n+1}_{(i)(j+1)}$, $T_3=m^{n+1}_{(i+1)(j)}$, $T_2=m^{n+1}_{(i+1)(j+1)}$, $T_{10}=m^{n+1}_{(i+1)(j-1)}$, $T_1=m^{n+1/2}_{(2i)(j)}$, $T_0=m^{n+1/2}_{(2i+1)(j)}$, where T_6 through T_7 and T_1 correspond to pixels in said half-higher spatial object layer, and T_5 through T_2 and T_{10} correspond to pixels in a lower spatial object layer.

13. The method of claim 10, wherein said coding step (e) codes in a second pass said current region having a plurality of pixels, wherein at least one of said plurality of pixels is coded contextually in accordance with:

$$Context_5 = (T_9<<7)|\ (T_8<<6)|\ (T_7<<5)|\ (T_6<<4)|\ (T_5<<3)|\ (T_4<<2)|\ (T_3<<1)|\ (T_2),$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_5$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_9=m^{n}_{(i)(2j-1)}$, $T_8=m^{n}_{(i+1)(2j-1)}$, $T_7=m^{n}_{(i-1)(2j+1)}$, $T_6=m^{n}_{(i-1)(2j)}$, $T_5=m^{n+1/2}_{(i)(j)}$, $T_4=m^{n+1/2}_{(i+1)(j)}$, $T_3=m^{n+1/2}_{(i)(j+1)}$, $T_2=m^{n+1/2}_{(i+1)(j+1)}$, and where T_6 through T_9 correspond to pixels in a current higher object layer and T_5 through T_2, correspond to pixels in a lower spatial object layer.

14. The method of claim 10, wherein said coding step (e) codes in a second pass said current region having a plurality of pixels, wherein at least one of said plurality of pixels is coded contextually in accordance with:

$$Context_6 = (T_1<<7)|\ (T_{10}<<6)|\ (T_7<<5)|\ (T_6<<4)|\ (T_5<<3)|\ (T_4<<2)|\ (T_3<<1)|\ (T_2),$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_6$ is a context for said at least one pixel to be coded, i and j

are respectively row index and column index, $T_7=m^n_{(i-1)(2j+1)}$, $T_6=m^n_{(i-1)(2j)}$, $T_5=m^{n+1/2}_{(i)(j)}$, $T_4=m^{n+1/2}_{(i+1)(j)}$, $T_3=m^{n+1/2}_{(i)(j+1)}$, $T_2=m^{n+1/2}_{(i+1)(j+1)}$, $T_{10}=m^{n+1/2}_{(i-1)(j+1)}$, $T_1=m^n_{(i)(2j)}$, and where T_6 through T_7 and T_1 correspond to pixels in a current higher object layer and T_5 through T_2, and T_{10} correspond to pixels in a lower spatial object layer.

15. The method of claim 1, wherein said coding step (e) codes a current region within said next higher layer of said plurality of object mask layers contextually using binary context-based arithmetic coding.

16. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_7 = (T_7<<7) \mid (T_6<<6) \mid (T_5<<5) \mid (T_4<<4) \mid (T_3<<3) \mid (T_2<<2) \mid (T_1 <<1) \mid T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_7$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_7=m^n_{(2i-1)(2j)}$, $T_6=m^n_{(2i-1)(2j+1)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_7 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

17. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_8 = (T_8<<8) \mid (T_7<<7) \mid (T_6<<6) \mid (T_5<<5) \mid (T_4<<4) \mid (T_3<<3) \mid (T_2<<2) \mid (T_1 <<1) \mid T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_8$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_8=m^n_{(2i)(2j)}$, $T_7=m^n_{(2i-1)(2j)}$, $T_6=m^n_{(2i-1)(2j+1)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_8 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

18. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_9 = (T_9<<9) \mid (T_8<<8) \mid (T_7<<7) \mid (T_6<<6) \mid (T_5<<5) \mid (T_4<<4) \mid (T_3<<3) \mid (T_2<<2) \mid (T_1<<1) \mid T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_9$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_9=m^n_{(2i)(2j+1)}$, $T_8=m^n_{(2i)(2j)}$, $T_7=m^n_{(2i-1)(2j)}$, $T_6=m^n_{(2i-1)(2j+1)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_9 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

19. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_{10} = (T_{10}<<10) \mid (T_9<<9) \mid (T_8<<8) \mid (T_7<<7) \mid (T_6<<6) \mid (T_5<<5) \mid (T_4<<4) \mid (T_3<<3) \mid (T_2<<2) \mid (T_1<<1) \mid T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_{10}$ is a context for said at least one pixel to be coded, i and

j are respectively row index and column index, , $T_{10}=m^n_{(2i+1)(2j)}$, $T_9=m^n_{(2i)(2j+1)}$, $T_8=m^n_{(2i)(2j)}$, $T_7=m^n_{(2i-1)(2j)}$, $T_6=m^n_{(2i-1)(2j+1)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_{10} through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

20. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_{12} = (T_6<<6)\,|\,(T_5<<5)\,|(T_4<<4)|\,(T_3<<3)\,|\,(T_2<<2)\,|\,(T_1<<1)|\,T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_{12}$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_6=m^n_{(2i)(2j)}$, $T_5=m^n_{(2i-1)(2j)}$, $T_4=m^n_{(2i-1)(2j+1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_6 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

21. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_{13} = (T_7<<7)\,|\,(T_6<<6)|\,(T_5<<5)\,|(T_4<<4)|\,(T_3<<3)\,|\,(T_2<<2)\,|\,(T_1<<1)|\,T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_{13}$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_7=m^n_{(2i)(2j)}$, $T_6=m^n_{(2i)(2j+1)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_7 through T_4 correspond to pixels in a current

higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

22. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_{14} = (T_6<<6) | (T_5<<5) | (T_4<<4) | (T_3<<3) | (T_2<<2) | (T_1<<1) | T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_{14}$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, , $T_6=m^n_{(2i)(2j)}$, $T_5=m^n_{(2i)(2j+1)}$, $T_4=m^n_{(2i+1)(2j)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_6 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

23. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_{15} = \text{if } (T_1>T_2),$$
$$\text{then } ((T_7<<7) | (T_6<<6) | (T_5<<5) | (T_4<<4) | (T_3<<3) | (T_2<<2) | (T_1<<1) | T_0);$$
$$\text{else } ((T_5<<7) | (T_4<<6) | (T_7<<5) | (T_6<<4) | (T_3<<3) | (T_1<<2) | (T_2<<1) | T_0),$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_{15}$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_7=m^n_{(2i-1)(2j)}$, $T_6=m^n_{(2i-1)(2j+1)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_7 through T_4 correspond to pixels in a current

higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

24. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_{16} = (T_6<<6) | (T_5<<5) | (T_4<<4) | (T_3<<3) | (T_2<<2) | (T_1<<1) | T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_{16}$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_6=m^n_{(2i)(2j)}$, $T_5=m^n_{(2i-1)(2j)}$, $T_4=m^n_{(2i-1)(2j+1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_6 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

25. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$Context_{17} = (T_6<<6) | (T_5<<5) | (T_4<<4) | (T_3<<3) | (T_2<<2) | (T_1<<1) | T_0,$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, $context_{17}$ is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_6=m^n_{(2i)(2j)}$, $T_5=m^n_{(2i)(2j-1)}$, $T_4=m^n_{(2i+1)(2j-1)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i+1)(j)}$, $T_1=m^{n+1}_{(i)(j+1)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_6 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

26. The method of claim 15, wherein said current region has a plurality of pixels, and wherein said coding step (e) codes at least one of said plurality of pixels of said current region within said next higher layer of said plurality of object mask layers contextually in accordance with:

$$\text{Context}_{18} = \text{if } (T_1 > T_2)$$
$$\text{then } ((T_6<<6) \mid (T_5<<5) \mid (T_4<<4) \mid (T_3<<3) \mid (T_2<<2) \mid (T_1<<1) \mid T_0);$$
$$\text{else } ((T_6<<6) \mid (T_4<<5) \mid (T_5<<4) \mid (T_3<<3) \mid (T_1<<2) \mid (T_2<<1) \mid T_0),$$

where "<<" is a left-shift operation and "|" is a bit wise logical OR operation, context_{18} is a context for said at least one pixel to be coded, i and j are respectively row index and column index, $T_6=m^n_{(2i)(2j)}$, $T_5=m^n_{(2i)(2j+1)}$, $T_4=m^n_{(2i+1)(2j)}$, $T_3=m^{n+1}_{(i)(j)}$, $T_2=m^{n+1}_{(i)(j+1)}$, $T_1=m^{n+1}_{(i+1)(j)}$, $T_0=m^{n+1}_{(i+1)(j+1)}$, and where T_6 through T_4 correspond to pixels in a current higher object layer and T_3 through T_0 correspond to pixels in a lower spatial object layer.

27. A computer-readable medium having stored thereon a plurality of instructions, the plurality of instructions including instructions which, when executed by a processor, cause the processor to perform the steps comprising of:

(a) assigning at least one symbol to each of the plurality of regions;

(b) coding said assigned symbols of the input object mask;

(c) decomposing said input object mask into a plurality of object mask layers;

(d) coding a base object layer of said plurality of object mask layers; and

(e) coding a next higher layer of said plurality of object mask layers in accordance with information from a lower object mask layer.

28. The computer-readable medium of claim 27, wherein said coding step (b) codes said assigned symbols contextually in accordance with neighboring regions.

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29. An apparatus for coding an input object mask, where said input object mask has a plurality of regions, said method comprising the steps of:

means for assigning at least one symbol to each of the plurality of regions;

a first means for coding said assigned symbols of the input object mask;

means for decomposing said input object mask into a plurality of object mask layers;

a second means for coding a base object layer of said plurality of object mask layers; and

a third means for coding a next higher layer of said plurality of object mask layers in accordance with information from a lower object mask layer.

30. The apparatus of claim 29, wherein said first coding means codes said assigned symbols contextually in accordance with neighboring regions.